THE CHROMITE DEPOSITS OF THE STATE LINE SERPENTINES.[1]

By Samuel G. Gordon.

The chromite deposits described below occur in a belt of serpentine situated on the Pennsylvania-Maryland line, in Lancaster and Chester counties, Pennsylvania, and Cecil County, Maryland. In the last century the district was an important producer of chromite, and during the recent war attempts were made to reopen the mines, but with little success. Aside from economic considerations, the deposits are of considerable scientific interest, as the data regarding chromite deposits are rather meager, beyond the fact that they appear to be true magmatic segregations without the aid of "mineralizers."

General Geology.

The geology of the district has been described by Rogers[2], Chester[3], Frazer[4], and Bascom[5]. The serpentines of the belt represent hydrothermal-metamorphosed peridotites and pyroxenites, part of an igneous complex forming a large batholithic mass overlain on the north by mica gneisses. The following interesting petrographic succession is exhibited in passing northwestward across the batholith-biotite-grandiorite, hornblende-biotite-granodiorite, quartz-biotite-hornblende-gabbro, quartz-hornblende-gabbro, hornblende-norite and quartz-norite, norite, pyroxenite, and peridotite. The main types are considered by F. Bascom to represent differentiation of the magma before intrusion, while their gradations are thought to represent subsequent differentiation.

[1] The writer is indebted to Dr. Edgar T. Wherry for a critical review of the manuscript, and to Mr. F. Lynwood Garrison for various courtesies extended to him during his visit to the district in April and August, 1920. The albitites were described in a previous article in these proceedings, and an account of the minerals of the district will appear in The American Mineralogist.

[2] Henry D. Rogers, Geology of Pennsylvania, 1858

[3] Frederick D. Chester, Ann. Rep. Second Geol. Surv. Penna. 1887, 93-105, 1889.

[4] Persifor Frazer, Jr., Second Geol.Surv. Penna. Reports C3 and C4, 1880 and 1883, Geology of Lancaster County and Chester County.

[5] F. Bascom, Cecil County; Maryland Geol. Surv. 1902, 83-148.

Chromite Deposits.

The chromite deposits occur exclusively in the meta-pyroxenite and meta-periodotite area. The principal mines, now all abandoned, are listed below, with their reputed production.[6]

Line Pit, three-quarters of a mile northwest of Rock Springs cross-roads, Maryland; 1,000 tons. This chromite body presents a number of unusual features, and is in some respects the most remarkable deposit in the district.

The deposit may be described as a rough, irregular cylindrical mass, with the average diameters of 5 by 8 feet, which has been worked to a depth of about 250 feet. The chromite body pitches S 75° E at an angle of about 60°.

This rough cylindrical mass is surrounded by a thick sheathing of a translucent green, jade-like serpentine known as williamsite, averaging about a foot in thickness, beyond which lie the ordinary types of serpentine. Thick tabular masses of williamsite form partings in the chromite deposit, while veins of it may extend into the serpentine walls. Fractures in the chromite are filled with clinochlore or kammererite. Many veins of magnesite, containing residual masses of green serpentine, were found cutting the chromite deposit and the serpentine in the lower levels.

Reynolds' Mine, one and a half miles south of Wrightsdale; production small.

Wood's Mine, one mile southwest of Lee's Mill; 120,000 tons. The Wood's Mine chromite deposit formed an enormous, irregular mass, in a dark green serpentine, which assumes a brown coating on weathering. The deposit was worked to a depth of 720 feet. The greatest length along the strike was 300 feet, with a width of 10 to 35 feet, and a pitch of 40° to 60°. The strike was nearly E. and W. at the outcrop, and N. and S. on the lower levels. Branches of the chromite body occasionally extended into the serpentine.[7]

Adjacent to the chromite, the serpentine showed a prismatic structure, the cracks of which extended normally to the chromite for a distance of a half inch or more, and were filled with deweylite or magnesite. This secondary phenomenon occurred during the serpentinization of the peridotite or pyroxenite, and indicates that

[6] For a map see these Proceedings Vol. 73, p. 174.

[7] Persifor Frazer, Jr., Second Geol. Surv. Penna. Rep. C3, 1880, 192–196. William Glenn, Trans. Am. Inst. Min. Eng. 25, 481-499, 1896.

the chromite deposit was formed prior to the serpentinization. A similar structure is found in the serpentine adjacent to magnetite veins in Brinton's Quarry, three miles south of West Chester, Chester County, Penna.

The following minerals were found associated with the chromite, clinochlore, kammererite, uvarovite, brucite, hydromagnesite, genthite, and zaratite.

Red Pit, one-half mile northeast of Line Pit; production unknown.

Jenkin's Pit, three-eighths of a mile northeast of Red Pit; 1,000 tons. This mine has been abandoned for a number of years, and the writer's observations were limited to the material on the dumps.

In addition to massive chromite much disseminated chrome, known as "birds-eye ore" was mined. The chromite deposits occurred in dark brown, light to dark-greenish, or almost black serpentines, which under the hand lens are seen to consist of greenish translucent grains. Under the microscope the serpentine shows characteristic mesh structure with residual grains of olivine (fig. 1). The disseminated chromite occurs as rounded grains in a light greenish serpentine, with residual olivine. Occasional grains of serpentinized olivine are found entirely enclosed by chromite (fig. 2), and study of thin sections indicates that the chromite crystallized out from the magma contemporaneously with the olivine.

The clinochlore and kammererite form druses in the chromite, having been deposited by hydrothermal solutions, perhaps during the process of serpentinization. The genthite and zaratite are due to the weathering of minute amounts of an undetermined nickel sulfide present in the chromite.

Carter's Mine, three-eighths of a mile east of Wood's Mine; 400 tons.

Scott's Mine, two miles southwest of Nottingham; 3,000 tons.

Moro Phillips' Mine, one mile south of Nottingham; 250 tons.

In addition a number of smaller pits have produced from 20 to 50 tons, while more than 5,000 tons of sand chrome has been reported to have been obtained by washing the stream sands of the region.

An abandoned magnetite mine is situated one-and-a-quarter miles northeast Rock Springs cross-roads, Maryland.

The Serpentines. The serpentines forming the country rock are largely brownish or greenish rocks, which are seen under the hand lens to consist of small greenish, translucent grains, separated by films of magnetite particles. Under the microscope some of the

grains exhibit mesh structure and contain residual olivine, indicating that the parent rocks were largely peridotites of the type

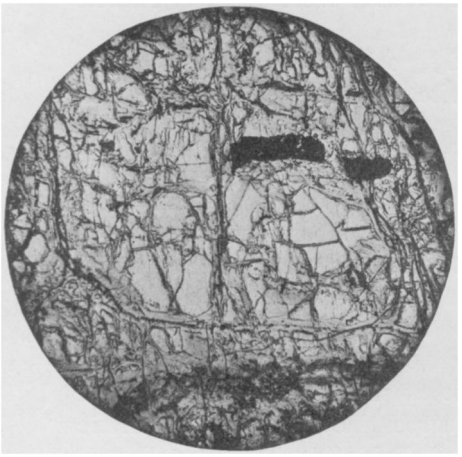

Fig. 1.

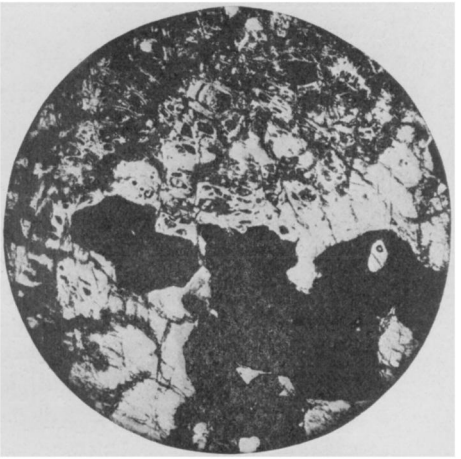

Fig. 2.

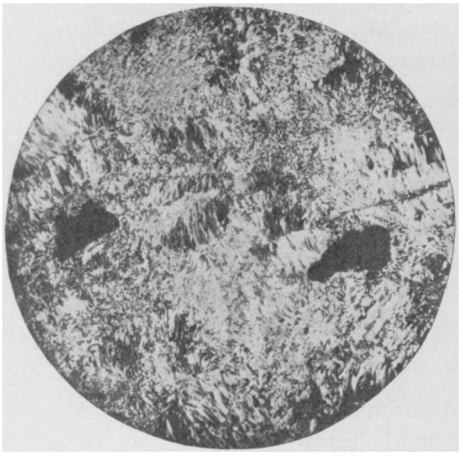

Fig. 3.

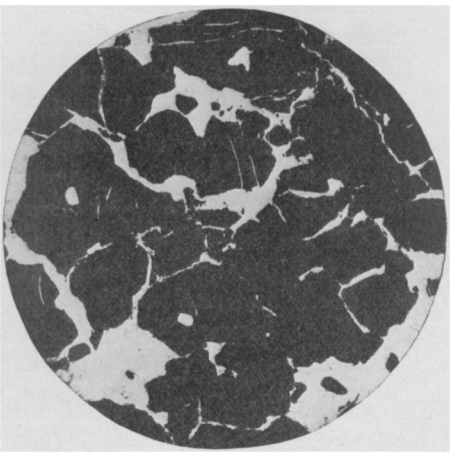

Fig. 4.

Fig. 1. Serpentinization proceeding along cracks in olivine. Jenkin's Mine. Ordinary light, x 15. Fig. 2. Chromite, "birdseye ore," in more or less serpentinized olivine. Note rounded form of chromite and serpentinized olivine crystal in the chromite. Jenkin's Mine. Ordinary light, x 15. Fig. 3. Chromite in fibrous williamsite. Line Pit. Polarized light, x 15. Fig. 4. Chromite in williamsite. Note fractured character of the chromite. Line Pit, ordinary light, x 15.

saxonite, composed of olivine and enstatite. A pseudo-porphyritic type is found consisting of a light grayish-green serpentine, with small patches rich in magnetite, the particles of which are arranged in definite patterns, indicating a possible derivation from a ferriferous pyroxene, probably hypersthene.

The williamsite is a compact, green, translucent, jade-like serpentine, which under the hand lens shows a fibrous structure. Under polarized light the rock is seen to be composed of aggregates of fibres polarizing in first order gray and yellow colors (fig. 3). Rarely minute particles of a silver-white undetermined nickel sulfide may be found in the williamsite. Mesh structure is absent and no traces of the parent mineral from which the williamsite is derived occurs. The writer considers the mineral to have been derived from enstatite by hydrothermal metamorphism.

Analyses of the williamsite are given below, showing it to be a pure serpentine.

ANALYSES OF WILLIAMSITE

Line Pit, Lancaster County, Penna. Smith and Brush; Am. J. Sci. (2) 15 213, 1853.

	A	B
SiO_2	41.60	42.60
Al_2O_3	tr.	tr.
NiO	0.50	0.40
FeO	3.24	1.62
MgO	39.71	41.11
H_2O	12.70	12.70
	99.15	99.22

Chromite. The chromite forms granular black masses, and contains some disseminated williamsite. In very thin sections the mineral shows a reddish translucency, and evidence of fracturing during the period of serpentinization (fig. 4).

Origin of the Line Pit deposit. It is at once apparent from the form and position of the Line Pit deposit that it was formed later than the surrounding rock. Unfortunately but little is known regarding the behavior of chromite in igneous melts, beyond the fact that its occurrence is limited to the ultrabasic rocks and that it begins to crystallize early, and the period of its crystallization may overlap that of the enstatite.

That the chromite deposit had been formed previous to the serpentinization is indicated by the evident fracturing of the chromite grains (fig. 4) which occurred during this process.

It seems, therefore, that after most of the magma had crystallized into the peridotite, and the pipe-like mass of liquid was injected into the peridotite, where after further differentiation, the material crystallized into enstatite and chromite. Hydrothermal solutions later altered the enstatite to williamsite.

The Line Pit, Red Pit, Jenkins' Mine and Reynolds' Mine deposits all fall on a line on the map. The significance of this is not known.